ATTACHMENT - REMARKS

By this Amendment, independent claim 23 has been amended to better define the invention (the remaining claims otherwise indicated as being in condition for allowance). It is submitted that the present application is in condition for allowance for the following reasons.

In the *Claim Rejections - 35 USC § 103* section of the outstanding final action, independent claim 23 was rejected under 35 USC § 103 as being obvious over Tokoro in view of Baur. However, for the following reasons, it is submitted that amended independent claim 23 is allowable over this combination of references.

By this Amendment, independent claim 23 has been amended to clarify the nature of the material of the balance spring. This clarification has already considered in allowable dependent claim 20 (but with the recitations reversed), with both recitations based on the description provided at page 14, line 16 to page 15, line 4 of the specification.

The present invention as now claimed in independent claim 23 is concerned with providing a balance spring made of a material which enables a thermal timekeeping change U to be minimized so that the period T of a mechanical oscillator in which it operates remains as constant as possible during changes in temperature,

where $U = \alpha_1 - \frac{3}{2}\alpha_2 - \frac{1}{2}\frac{\partial E}{E}$, and

where $T = 2\pi\sqrt{\frac{12Mr^2l}{Ehe^3}}$.

As amended, independent claim 23 thus recites that the material of the balance spring is selected so that its thermal expansion coefficient and thermoelastic coefficient enable thermal variation to be compensated for by causing a decrease in length and an increase in thickness with

increase in temperature. It may be seen that this change in behavior can enable compensation in oscillators in which r increases with temperature (e.g., an uncompensated balance wheel with positive α_1) and in which the spring has a normal negative thermoelastic coefficient (i.e., E decreases with increase in temperature).

Neither US 6705601 (Baur) nor US 2002/0167865 (Tokoro) discloses a balance spring material having a coefficient of thermal expansion and a thermoelastic coefficient arranged to cooperate with a coefficient of thermal expansion of a balance by decreasing in length and increasing in thickness with increase in temperature. Baur discloses a spring material with an abnormal positive thermoelastic coefficient. In other words, compensation in Baur is achieved by providing an increase in E with temperature (e.g., to balance an increase in r).

In Tokoro, the spring is made of carbon nano-fibers integrally molded in a resin (see paragraph [0021]). The thermal behavior of the resin dominates how the spring reacts with temperature change because it is what binds the (small) nano-fibers together. Tokoro does not disclose a material that provides the behavior now recited in claim 23 as amended. The resin used in Tokoro behaves in an isotropic manner, i.e., has a coefficient of thermal expansion that would cause the spring to increase in length and thickness with an increase in temperature.

When considering Baur and Tokoro in totality, a skilled person is therefore directed to achieve thermal compensation by investigating the thermal evolution of Young's modulus. Neither Baur nor Tokoro suggest that thermal compensation is possible using a spring with a normal negative thermoelastic coefficient. The invention as claimed in independent claim 23 enables such thermal compensation by providing a spring which behaves anisotropically with an increase in temperature. None of the cited documents disclose a composite material or a polymer, carbon or ceramic material which exhibits such anisotropic behavior.

As amended, independent claim 23 clarifies the manner in which compensation is achieved. The final sentence of the Office Action suggests that thermal compensation according to the equations in Baur may be achieved by constructing the carbonized resin in Tokoro in a number of ways. However, there is no disclosure in the cited art which teaches how this could be achieved to provide a spring which achieves thermal compensation by decreasing in length and increasing in thickness with increase in temperature as claimed in amended claim 23.

It is therefore submitted that the subject matter of independent claim 23 as now amended is patentable with respect to Baur and Tokoro.

As the remaining claims 1-4, 6, and 9-22 have already been indicated as being allowable, it is submitted that the present application is in immediate condition for allowance and such action is solicited.

Respectfully submitted,

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